Implicit learning a sequence of body movements

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Introduction

Typically, implicit sequence learning is tested with a visuo-motor serial reaction time task. Recently, implicit learning was also demonstrated for sequences of tasks, at least when they were correlated with an additional stream of information (Meier & Cock, 2010). Here, we investigated whether sequences of motions can also be learned.

Results

Accuracy was high (94.8%; SE=.005) and did not differ across blocks and experiments. Median RTs for each motion axis were averaged individually for each participant. Trajectories across blocks and learning scores are presented. Significant learning scores are highlighted by an asterisk (alpha was set at .05). Error bars indicate standard errors.

Method

A total of 100 young adults participated in this study (Exp 1: N=22, Exp 2: N=40, Exp 3: N=19, Exp 4: N=19). They were seated and blindfolded in a chair that was mounted on a MOOG motion platform. They were instructed to discriminate up-down, left-right and front-back platform motions by pressing one of two response buttons with their left or right thumb according to a specific response mapping (i.e., left key for up, left, and front; right key for down, right, and back). Each motion lasted 500ms and displaced the participant by 2 cm. The motions were pre-tested in order to be clearly distinguishable. A fixed response to stimulus interval of 900 ms was used. Each Experiment was composed of 8 Blocks with 96 motions. To assess sequence learning a 12-element sequence was embedded in the motion axis, the required responses, or both.

Experiment Structure

Practice (random)	Practice (random)	Sequenced	Sequenced	Sequenced	Sequenced	Transfer	Sequenced
Block 1	Block 2	Block 3	Block 4	Block 5	Block 6	Block 7	Block 8

Sequence learning is assessed as the difference between Block 7 and the surrounding Blocks 6 and 8

Experiment Overview

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Experiment 1: Motion sequenced and motor response sequenced (correlated streams)

Motion Axis	X	Y	Z	Y	Z	X	Z	Y	X	Y	X	Z
Direction	down	left	back	right	front	down	back	right	up	left	up	front
Motor Response	right	left	right	right	left	right	right	right	left	left	left	left

In Transfer Block 7 both sequences are switched to (pseudo-)random

Experiment 2: Only motor response sequenced

Motion Axis	(pseudo-) random											
Direction	down right back	up left front	down right back	down right back	up left front	down right back	down right back	down right back	up left front	up left front	up left front	up left front
Motor Response	right	left	right	right	left	right	right	right	left	left	left	left

In Transfer Block 7 the motor response sequence is also switched to (pseudo-)random

Experiment 3: Only motion sequenced

Motion Axis	X	Y	Z	Y	Z	X	Z	Y	X	Y	X	Z
Direction	up down	left right	back front	left right	back front	up down	back front	left right	up down	left right	up down	back front
Motor Response	(pseudo-) random											

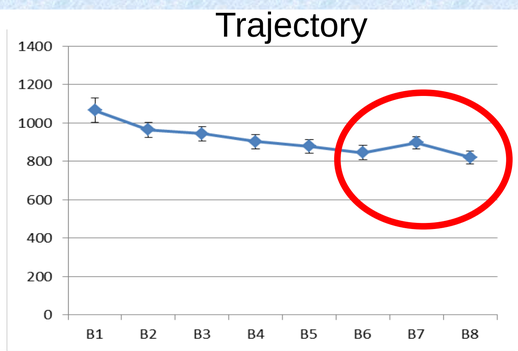
In Transfer Block 7 the motion sequence is also switched to (pseudo-)random

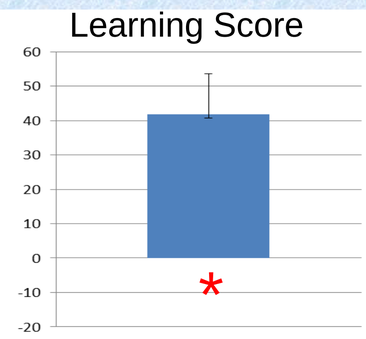
Experiment 4: Motion sequenced and response sequenced (correlated streams)

Motion Axis	X	Y	Z	Y	Z	X	Z	Y	X	Y	X	Z
Direction	down	left	Back	right	front	down	back	right	up	left	up	front
Motor Response	right	left	Right	right	left	right	right	right	left	left	left	left

In Transfer Block 7 only the motion sequence is also switched to (pseudo-)random

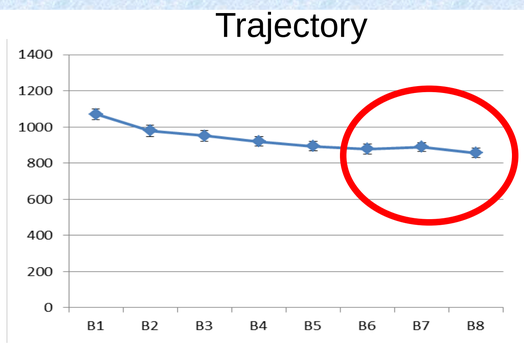
Experiment 1: Motion sequenced and motor response sequenced

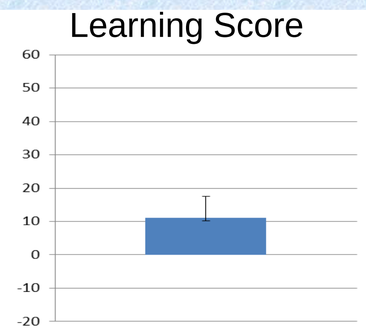




Evidence for learning a correlated motion and response sequence

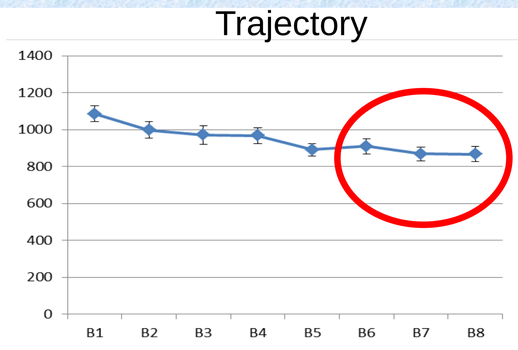
Experiment 2: Only motor response sequenced

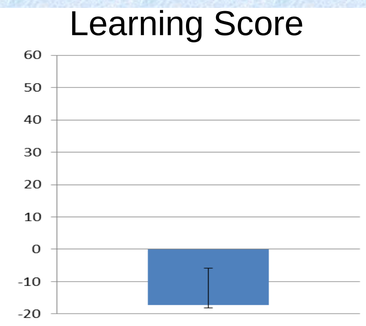




No response sequence learning alone

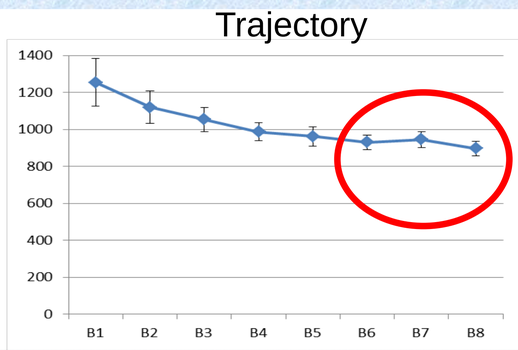
Experiment 3: Only motion sequenced

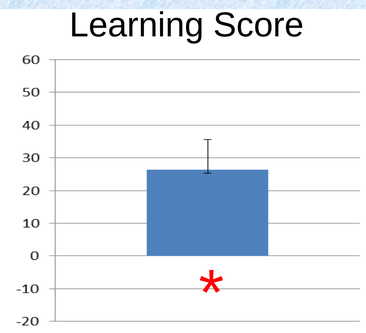




No motion sequence learning alone

Experiment 4: Correlated sequences - transfer to random motion





Evidence for sequence integration

Conclusions

The results indicate that sequence learning occurred specifically when correlated sequences were present. Thus, 3D body motion information can be integrated into a comprehensive sequence representation.

Reference:

Meier, B., & Cock, J. (2010). Are correlated streams of information necessary for implicit sequence learning? Acta Psychologica, 133, 17-27. doi: 10.1016/j.actpsy.2009.08.001

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